

AIR COMMAND AND STAFF COLLEGE

AIR UNIVERSITY

PUBLIC SUPPORT AS A CENTER OF GRAVITY FOR NATIONAL SPACE POWER

by

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Abstract

Public support shapes how our government operates, writes policy and ultimately spends money. It is also a key component for the nation's ability to project space power, capabilities the United States of America is heavily dependent on not just for government operations across diplomatic, information, economic and military sectors, but the daily lives of its citizens as well.

Since space power is a vital national interest of the United States, it must be protected. When military planners plan for military operations to support national level objectives, a key part of their planning is the protection of the ability to operate unhindered in space (otherwise known as Defensive Space Control). Normally planners think of Defensive Space Control operations in the conventional warfare sense; protecting the satellites and ground stations from attack, securing the global commons of the space lanes (orbits) and electronic magnetic spectrum in which they operate, and evening planning for the reconstitution of those forces should they be neutralized (just to name a few areas of consideration).

An approach to planning for the protection of space power that is not often considered is to look at space in terms of irregular warfare. In irregular warfare, as with Colonel John Warden's five rings model for strategic attack, population is considered a key center of gravity. The approach of this paper is to examine how the public support (or "population" as described in Warden's five rings) of space can be thought of as an important national level center of gravity for the United States space power capability. The first section of this paper discusses why public support is a national level center of gravity and then walks through the critical factor analysis planners conduct to break the center of gravity down into critical capabilities, critical requirements, and critical vulnerabilities. The second section examines the history of public support from the early days of the space race during the cold war through the Apollo moon-

landing program and concludes with recent space disasters, all events that have affected public support for space. The third section focuses on the challenges of today as budgets shrink and other countries bolster their own space programs' public support to achieve their national objectives. The paper concludes with a look at a few tools planners and policy makers at the national level can use to protect and bolster the public support center of gravity.



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“Winning the population’s support for strategic objectives and desired end state is paramount.”

-- United States Air Force Doctrine on Irregular Warfare (Annex 3-2)

Introduction

In the movie *The Right Stuff*, a movie detailing the early years of America’s space program, actor Fred Ward (portraying NASA astronaut Virgil “Gus” Grissom) states, “No bucks...no Buck Rogers.”¹ This simple statement epitomizes one of the most important drivers in technological dominated fields like aviation and especially space programs (commercial, military or civil). But what is the driving force behind funding? Public support, whether from individuals or special interest groups, shape how our government operates and ultimately spends its money. This makes public support an important national level center of gravity for the United States’ space power capability.

The first section of this paper will examine what makes public support an important national level center of gravity for space power, one that is often overlooked when examining a nation’s space capability. This section will then break down the public support center of gravity into its critical capabilities, critical requirements, and critical vulnerabilities to show one outcome of the critical factor analysis.

The second section will look back at what many people view as the time when public support for space was “the most popular,” during the Apollo moon landings, and how public opinion appeared to influence the development of the United States’ space program.²

The third section will focus on the current situation with public support and how it is affecting other spacefaring nations like China and Russia. Finally this section will also address the commercialization of space and how they may provide a way forward.

The final section of this paper will look at possible ways to increase the level of public support for the United States' space programs (civil and military), defending this important national center of gravity. Now let us examine why space is important to the nation and why public support should be identified as a national level center of gravity.

Section 1: Public Support as a Center of Gravity for Space Power

Space plays an important part in the daily life of most people on Earth, even if they do not realize it. Technologically advanced nations, such as the United States of America, are especially reliant on space services in both the civilian and military sectors. When most people think about space they think of the astronauts, the space shuttle and even the space station. But they perceive little benefit from space beyond the global positioning system (GPS) enabled direction software in their car or the television signal bouncing off a DirecTV satellite in geostationary orbit. In truth, when you look closer you will find that the very fabric of modern society is made possible by space effects. The timing signal provided by the GPS constellation is used from everything such as helping astronomers “perform simultaneous observations at distant locations” to “banking communication networks [that] have special timing requirements for synchronization of data encryption and decryption equipment.”³ Satellite communication has helped to shrink the world to become a “global village”, where calling your friend across the world is just as easy as calling your best friend right across town.⁴ Remote sensing satellites help farmers predict “the failure of a harvest”, help “manage scarce resources”, and even “predict where locust swarms [are] breeding”; all this has helped “improve food production and crop management worldwide.”⁵ The list of beneficial space effects goes on and could be the topic for an entire presentation by itself. The big problem with most space effects is their transparency (they operate seamlessly in the background) to most people; so they take them for granted. If

something is taken for granted, it is unlikely to receive the attention it requires, both in education and in funding. From a governmental (civil and military alike) view, why is space so important? In two words: space power.

Space power is defined as “the ability of a state or non-state actor to achieve its goals and objectives in the presence of other actors on the world stage through...exploitation of the space environment.”⁶ From a governmental perspective then space power (like airpower) is “the ability to use spacecraft[s] to create military and political effects,” potentially putting “an adversary in a position of disadvantage.”⁷ Indeed, General William Shelton, the commander of Air Force Space Command, stated, “I can’t think of a single military operation across the full spectrum from humanitarian relief operations all the way to major combat operations that doesn’t somehow depend on space for mission success.”⁸ Because of the importance of space in all military operations, it must be planned for during the operational planning process. Often the best way to understand an adversary’s (or friendly’s) capabilities, strengths and weaknesses is to analyze their centers of gravity and is “a key step in operational design (a part of the joint operations planning process).”⁹

The 19th century Prussian military general/theorist, Carl Von Clausewitz wrote about the concept of centers of gravity in his book *On War*. Basically a center of gravity is “the most effective target for a blow [to strike]” and from which “the heaviest blow is that struck by the center of gravity.”¹⁰ In today’s military jargon a center of gravity is “the source of power, moral or physical strength, freedom of action or will to act.”¹¹ Analyzing the centers of gravity, results in three levels of “critical factors” related to the center of gravity (“critical capabilities, critical requirements, and critical vulnerabilities”).¹² As this paper runs through a critical factor analysis on public support as a center of gravity for space power, the proceeding paragraphs will examine

each of the three levels of the center of gravity. So centers of gravity are important, but what specifically is public support about?

The population of a state/nation provides willpower to accomplish the state's goals; this takes the shape through public support. In Colonel John Warden's five-ring model, population (the fourth ring) represents the support of population. Warden says that population in any conflict needs to be "sympathetic and helpful in a variety of ways."¹³ In this context the population ring is synonymous with this paper's definition of public support. Government agencies like NASA and the Department of Defense are reliant of public support. NASA believes "[they] depend on the will of the people, as expressed through their senators and representatives and the president, for its funding and direction."¹⁴ This model for public support is how the American people influence and guide the direction of their government; the same type of influence cited above for NASA applies to the military sector of space. So if public support (aka the population) is a national center of gravity, how does the public support translate into a center of gravity for space power?

Traditionally when an analysis is done on space systems and their capabilities, the threats and vulnerabilities normally fall into one of three categories; the ground segment, the on-orbit segment, and the communications (link) segment between them.¹⁵ This is a very conventional way of thinking about targeting, one that has been applied to warfare for centuries; i.e. the targeting of conventional forces, troops and facilities. Even the concept of electronic warfare, such as targeting the communications segment of space systems, is something conventional forces have dealt going back to "early in World War II [which] started 'the move-countermove' development of radar, sensors, jamming, and countermeasures."¹⁶

In fact this conventional way of thinking about space power assets as centers of gravity is not new and was proposed by M.V. Smith. Smith, in his paper on *Ten Propositions Regarding Spacepower*, identifies several areas of space as centers of gravity. Proposition No. 7 states, “Space power assets form a national center of gravity.”¹⁷ In this specific example he is talking about the three segments of space systems, but he also goes on to discuss the space sectors of activities (civil, military, commercial, and intelligence) that should also be considered centers of gravity.¹⁸

In contrast, public support is more aligned with unconventional/irregular warfare. In irregular warfare (IW), “winning the population’s support for strategic objectives and [the] desired end state is paramount.”¹⁹ With public support for space power, just like IW, the population is “the essential element.”²⁰ The most important thing to remember about attempts to neutralize public support is “they should not be considered direct targets...because of ethical concerns” and really only become a player in “long-term conflicts.”²¹ Now let’s break apart the public support center of gravity through the critical factor analysis process.

Critical Factor Analysis: Public Support

The “Analysis of friend and adversary centers of gravity is a key step” in the planning process.²² The critical factor analysis takes into consideration “the best available knowledge” of “how the adversary organizes, fights, thinks, and make decisions, and their physical and psychological strengths and weaknesses.”²³ The same analysis is done when looking at one’s own capabilities to “identify critical vulnerabilities” to enable the protection of those capabilities.²⁴ The need to protect the public support for the United States space power is what this author is advocating. In the discussion above, public support has been shown as the center

of gravity that needs to be protected. The next step in the critical factor analysis is to determine the critical capabilities that comprise the center of gravity.

“Critical capabilities are those [factors] that are considered critical enablers for the center of gravity to function”.²⁵ For public support, two critical capabilities were identified; an education system that supports an educated population and special interest groups (e.g., lobbyists or advocacy groups). An educated population is the building block for public support, but this can’t be achieved without an education system that provides the knowledge to make that base educated. The second critical capability (special interest groups) connects the will of the people with the government that needs their support. Both of these critical capabilities have requirements, which enable them to perform their functions.

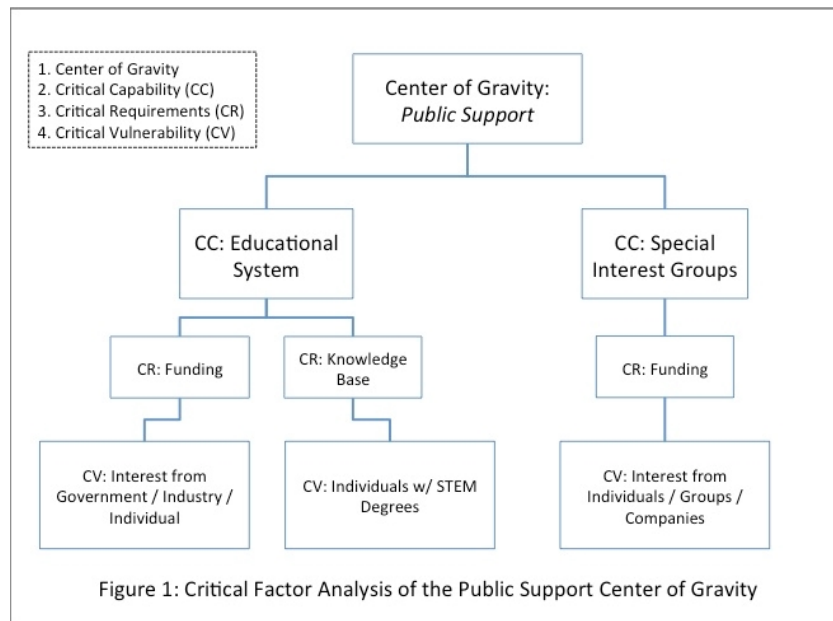
“Critical requirements are the conditions, resources, and means that enable the critical capability to become fully operational.”²⁶ For the first critical capability (the education system), two critical requirements are funding and a science, technology, engineering and mathematical (STEM) knowledge base. As mentioned in the introduction, without funding there can be “no Buck Rogers.”²⁷ A STEM knowledge base is critical because it provides the necessary information for the education system to teach the next generation. In the second critical capability, funding is the major critical requirement for the same reasons as it is required for the education system. These critical requirements can be exploited through their vulnerabilities.

“Critical vulnerabilities are those aspects or components of critical requirements that are deficient or vulnerable to direct or indirect attack in a manner achieving decisive or significant results.”²⁸ In the first example, for the education system, the two most likely critical vulnerabilities are interest from the government/industry or (as will be discussed in section 3) private individuals, and having individuals with STEM degrees. Interest from the

government/industry/individuals is important because it sets the requirement or demand signal that enables funds to be allocated for education. As for having educated individuals they provide the means for transferring STEM knowledge through the education system. This vulnerability is currently a hotly debated issue (touching not just education, but foreign policy and immigration reform)²⁹; historically (data from 1958 through 1980) the number of individuals in the United States with STEM PhDs was highest in 1971 (approximately 8,000 STEM PhDs)³⁰, “the relative growth rate since then has dropped drastically, even though the current number has gone up.”³¹ In 2011 the number of STEM PhDs was approximately 25,000.³² On the surface this is a positive step; the number of STEM PhDs is approximately three times higher now than in 1971. One note of caution, “40% of the 25,000 STEM Graduates PhD’s awarded in 2011 went to non-resident students,” making the real number of native US born PhD Graduates closer to 15,000.³³ While some of these non-resident graduates stay in the United States, “many STEM graduates leave the country.”³⁴ Those that leave take valuable skills back to their nation, knowledge that can be used to bolster their own STEM education system.

The second critical capability, since it has the same critical requirement of funding, shares the same critical vulnerability of the government/industry/individual interest.

It is important to note that when conducting analysis on a center of gravity, different factors can be identified as being of importance to a center of gravity. The analysis above is just one possible outcome and is based on factors the author sees as important (your own list of factors may be different). Figure 1. *Critical Factor Analysis of the Public Support Center of Gravity* can be referenced below for a graphical representation of this critical factor analysis.



Both education and special interests groups will be discussed in more detail in section four. Now let us examine how public support has influenced the development of the United States' space program (both military and civil).

Section 2: History of Public Support for Space Power

Before the launch of Sputnik I (the world's first satellite) in October of 1957, the public dreams of traveling to space resided in the realm of science fiction.³⁵ However there were men who were working on making those dreams a reality. Authors such as Jules Verne “inspired [scientists like] Dr. Werhner von Braun”, father of America's moon rocket (the Saturn V).³⁶ Space historian Walter McDougall stated, “the public's post-war [(WWII)] devotion to science fiction was a ‘form of cultural anticipation’ regarding the upcoming space age.”³⁷

Indeed even military minds were thinking about how space could be used to support and defend our nation. In 1945 the commander of the Army Air Forces, General Henry “Hap” Arnold, stated to the Secretary of War (Robert Patterson) “that the United States would soon be able to field ballistic missiles capable of delivering nuclear weapons half-a-world away and

[possess] 'space ships capable of operating outside the atmosphere'.”³⁸ Fear of war with the Soviet Union, “sparked research to make Arnold’s suggestions a reality.”³⁹ The main motivator behind the development of the United States’ space program was “the cold war”.⁴⁰ Fear is what drove public support in the early years of the cold war. The Soviets’ launch of Sputnik I was to the American public a “Pearl Harbor” level event and caused the public to fear that the United States was behind.⁴¹

The public’s fear “provided the impetus for increased spending for aerospace endeavors, technical and scientific educational programs and the chartering of new federal agencies to manage air and space research and development.”⁴² In short, the public support generated by Sputnik I enabled the United States government to allocate resources and to tap into the national will to get things done. President Johnson (then Senator) believed that “a concerted effort for both technology development and for national prestige” was important for the nation.⁴³

The entertainment industry, much as it did during World War II, was a key player in garnering public support for space in the early years of the space program. Walt Disney helped to engage the American public with space through his show “Man in Space” which first aired in 1955 and was viewed by “an estimated 45 million people.”⁴⁴ He combined his experience in entertainment with scientific experts such as Dr. Werhner Von Braun. Von Braun “believed that America’s devotion to space fiction in the early 1950s could be channeled into interest in space fact.”⁴⁵ Disney later said, after touring the Marshall Space Flight Center with Von Braun, “If I can help through my TV shows...to wake people up to the fact that we’ve got to keep exploring, I’ll do it.”⁴⁶

The next big jump in public support for space came in April of 1958 when the newly formed National Aeronautics and Space Administration (NASA) announced its selection of the first

seven astronauts.⁴⁷ Overnight these seven men “became heroes in the eyes of the American public”. The celebrity status of these seven astronauts enabled them to “exercise important influence over the direction of the program.”⁴⁸

In May of 1961, President John F. Kennedy “announced to the nation a goal of sending an American to the Moon before the end of the decade.”⁴⁹ This speech effectively kick started public support into overdrive. The increased numbers of “United States graduates in the science, technology, engineering and maths (STEM subjects), from high school to PhD...doubled” and it peaked shortly before the last moon landing (Apollo 17) in December of 1971.⁵⁰

Unfortunately just as easily as human exploration of space can bolster the nation’s interest in space, disaster can cause the public to question the necessity for human space travel. In 1986 the Space Shuttle Challenger was destroyed upon launch, killing all seven astronauts onboard.⁵¹ Many in the public raised concerns about why “seven people had died trying to get a satellite into orbit that could have been sent there on an expendable [rocket].”⁵²

This same argument resurfaced in 2003 when the Space Shuttle Columbia disintegrated after “A foam strike during launch.”⁵³ The Columbia Accident Investigation Board (CAIB) report stated, “the shuttle is now an aging system but still developmental in character. It is in the nation’s best interest to replace the space shuttle as soon as possible.”⁵⁴ Shortly after the announcement of the CAIB and other experts “led then-President George W. Bush to announce plans to retire NASA’s space shuttle fleet once construction of the International Space Station was completed.”⁵⁵ A 2010 estimate put the number of jobs lost at around “23,000 workers at and around the Kennedy Space Center” alone which breaks down to around “9,000 ‘direct’ space jobs and 14,000 ‘indirect’ jobs” from hotels, restaurants and all the other business in the

surrounding community.⁵⁶ The end of the shuttle program led to an uncertain time for the United States as 2014 began.

Section 3: Today's Public Support for Space

Sadly, 2014 finds the United States in an uncertain time regarding its ability to put man in space and the cascading 2nd and 3rd order effects this has on both the military and civil space sectors. In the last few years, since the retirement of America's space shuttle, the US government has had conflicting guidance on the direction of the space program.

The White House's proposed fiscal year (FY) 2015 budget for NASA supports the President's direction for NASA to continue planning for a deep space mission to an asteroid. Now called the "asteroid redirect mission"⁵⁷, this initiative would "redirect a small asteroid to lunar space, where astronauts could explore by 2025 using SLS [(space launch system; the next generation heavy lift rocket)] and Orion [(NASA's planned deep space exploration vehicle)]."⁵⁸ This plan is seen by some scientists and by Congress as the wrong set of priorities for NASA and has led to several proposed bills to replace the goal with "a Mars Exploration road map that would involve using the moon as a base for exploring the Red Planet."⁵⁹ This lack of a cohesive vision from policy makers and government leadership leads to excessive spending as administrations and congressmen change out of office. Furthermore, events like the government shutdown of 2013 cause even more delays and contracting issues. The "16-day shutdown" put "97% of NASA's 18,000 workforce" on the sidelines, keeping only essential support to the International Space Station and vital space probes online.⁶⁰ Public support for the entire government (not just the space sector) suffered as "Americans [were] angry at the government generally and everyone involved in the shutdown."⁶¹ Cuts to education and special program funds are also impacting "advanced placement courses" and "special academic programs for

science, foreign language, and technology.”⁶² Yet, despite these cuts to funding, the citizens of the United States find themselves heavily reliant on technology, including space technology.

Other countries realize the importance of space and technology, and are investing in both for their citizens and for the resulting national pride of being a spacefaring nation. Russia and China are two of these countries.

Russia has been a powerhouse in space since the beginning of space era in human history. Today space remains one of the most visible signs of its former glory days. Even though Russia has suffered “several launch failures” (but thankfully no losses of human life) in the last few years, they are willing to boost “space industry spending by more than 1.6 Trillion Rubles [(approx. \$280 Million US dollars) over the period of 2013-2020, which includes building new launch pads and developing rockets able to reach the moon and even mars.”⁶³

China, in contrast, is a relative new comer (especially with regards to human spaceflight); however they have made large leaps in a very short period of time. “It was only some ten odd years ago [(as of 2013)] that China sent its first astronaut, Yang Liwei, into space” and now “by 2020 intends to build a massive and permanently manned staffed space station of its own.”⁶⁴ Their swift progress worries many that China will overtake the United States and it will lose its dominance in space power if the United States doesn’t fully commit to ensuring its space power dominance. One possible outcome of a Chinese manned landing on the moon or mars is a renewed sense of competition (like the United States’ “fear of Soviet aggression” caused by the launch of Sputnik I)⁶⁵ and could serve as a badly needed wake-up call to America; albeit one that would be hard to recover from. Much like the space race during the cold war, Americans do best with competition. Indeed “it’s hard not to appreciate the excitement felt by a country so ambitious about and invested in government-led space travel.”⁶⁶ China is a good example of

what a focused government effort to inspire pride for its people can do for its own public support center of gravity.

All hope for United States' space power is not lost, as commercial companies and private investors are working at expanding the space industrial base. Elon Musk, CEO of Space Exploration Technologies Corp (SpaceX), "oversees development of rockets and spacecraft for missions to Earth orbit and ultimately to other planets."⁶⁷ His Dragon capsule was the first commercial spacecraft "to ever return a spacecraft from low-earth orbit."⁶⁸

"Inspiring the nation with the excitement of space travel" is the goal of Dennis Tito's (the world's first space tourist or space participant) Inspiration Mars mission.⁶⁹ His vision of sending a married couple to Mars is but one way to help capture the imagination of future generations and to bolster the public support for space. Now let's dive deeper into areas and methods that can be used to secure this center of gravity for the nation.

*"We need to think of public interest as a market. We have to figure out a way to tap into that market."*⁷⁰

-- Professor Ariel Anbar (Arizona State University)

Section 4: How to Protect the Public Support Center of Gravity

So if public support is a national center of gravity and public interest in space has atrophied since the end of America's moon program, how then is the United States' government to bolster public support and thereby protect the public support center of gravity? Protection of the center of gravity requires that the government view public support as something that needs to be protected. Second the enthusiasm about space and STEM education needs to be encouraged.

Finally, advocacy groups need to continue to spread the message about the importance of space to not just the public, but also their elected representatives within the government.

When the United States' military thinks of defending space assets, they use a term called defensive space control. Defensive space control (DSC) is "operations conducted to preserve the ability to exploit space capabilities via active and passive actions, while protecting friendly space capabilities from attack, interference, or unintentional hazards."⁷¹ While this definition talks a lot about the traditional space systems and concepts, we must always remember that public support is important for the long-term campaign.

"Policy-makers at the national level understand that the ultimate competitiveness of the United States is related to its ability to generate and utilize advanced technologies, which requires a workforce educated in science, mathematics, and engineering."⁷² One of the best ways to protect public support is to get the public excited about space and science; this process should begin at an early age. The good news is that there are organizations that encourage kids to become interested in math, science and engineering. One such organization is Space Camp, located at the Space and Rocket Center in Huntsville, Alabama. Space Camp was founded in 1982 with the goal to "inspire and motivate young people from around the country to join the ranks of space pioneers who persevere to push the boundaries of human exploration."⁷³ Over the last 32 years, "more than 600,000 trainees" have attended Space Camp.⁷⁴ Programs like Space Camp expose the next generation to the importance of space while also teaching "team work, leadership, [and] decision making."⁷⁵ Other educational opportunities like The Challenger Learning Center⁷⁶ (with programs all over the country) and The National Flight Academy⁷⁷ (based out of the National Aviation Museum in Pensacola, Florida) are just two additional examples of these types of programs. While some may view this as simply sending kids to camp

for a week, it can also be argued that this is an investment in ensuring a robust public support exists for space.

The hardest part about getting young folks excited about space is the dichotomy that exists between those that say the “space program will inspire young people to study science and mathematics” vs. the “common wisdom [held] in the United States that science, mathematics, and engineering are ‘hard’ subjects, to be avoided.”⁷⁸ So not only are these subjects avoided because they are seen as hard, but the teachers are often ill equipped to teach them even if they wanted to. A NASA survey found that “most teachers, especially at the elementary school level, have little or no background in the field [(especially astronomy and other space science)] and are unlikely to teach much of it without requirements to do so, or active training or assistance.”⁷⁹ So education (suggested as one of the critical capabilities of this center of gravity) and making it a priority is one area that needs attention at a systemic level. So can the media help with public support? A good model resides in the motion picture industry.

Hollywood is a potential resource for building enthusiasm and public support. In section 2 we already discussed how Walt Disney collaborated with rocket scientists of the day to create realistic and inspiring programming. Back in 1986, the movie *Top Gun* was filmed with the cooperation of the United States Navy and was reported, “To have boasted recruiting by 500%.”⁸⁰ If nothing else media like movies and television can be used to build public awareness and understanding of space. A potential problem area does arise when movies like *Gravity* are extremely popular, but as former astronaut Leroy Chiao stated are “full of big technical and operational inaccuracies.”⁸¹

If the glamour and glitz of Hollywood doesn’t shore up public support, then the fight needs to be taken directly to the government. The people that take issues up with the

government on behalf of small groups of citizens are known as lobbyists or advocates. The group formerly known as the American Association of Retired Persons (now simply AARP) is one of the most powerful political lobbies in Washington. They “advocate a range of federal health and fiscal issues that affect older Americans” for over “37 million members.”⁸² Space advocates are no different, though perhaps less publicly recognizable as the AARP. Indeed NASA lists nine prominent advocate groups on their headquarters website. Each group has its own specific interests within the space field; some favor Mars explorations, others advocate keeping humans out of space and instead promote the use of robot probes. The largest group is *The Planetary Society*, which boasts a membership of “more than 100,000”, and is heavily focused on “promoting exploration, [while] showing little interest in the grandiose vision of space industrialization and colonization.”⁸³ These conflicts between advocate groups are problematic as they prevent the space advocate groups from presenting a unified front in an arena where numbers matter. Simply put, “none, though, have reached the critical mass that gives them the influence on policy that much larger organizations, like AARP and the NRA, have on Capitol Hill.”⁸⁴ So if advocacy doesn’t work, then the job of reinforcing public support can come down to the government itself.

The government needs to sell the importance of space to the United States so the citizens understand why it is important to spend their tax dollars in space. If they understand the benefits they receive, they are more likely to see it as important. For example, the average citizen in the United States doesn’t realize that “for every US\$1 put into [the] US space agency [(NASA)], its citizens get US\$10 as payback.”⁸⁵ The payback from these investments take the form of the “thousands of inventions and innovations spun out of space research [and] have become an integral part of our daily life: weather forecasting, satellite communication...and global position

system.”⁸⁶ That’s a great return on an investment; countries like the European Union (EU) see about a “US\$3” return for every dollar spent.⁸⁷

One of the biggest benefits we (as a species) get from space is the fact that “space research has opened our eyes to real risks we face as a species: global warming, asteroids impacts, vulnerable ozone layer, and even warning about how our electronics would be affected by the sun.”⁸⁸ We are more aware of our surroundings both on the planet and in our own solar system. From a military perspective, having good space situational awareness (SSA) is critical to DCS because SSA “is fundamental to conducting space operations.”⁸⁹

In the end it may not be any single concept mentioned above that protects the public support for space power center of gravity. Instead a more full spectrum approach needs to be taken as every little bit helps to shore up the levee of public support.

Conclusion

Traditionally attacks on space systems are thought of in terms of conventional warfare. This paper has shown that if we think of attacking space using unconventional warfare tactics, then the support of the population (or public support as used by this paper) becomes an effective target to affect the enemy’s centers of gravity.

Since the United States is heavily reliant on the benefits of space power, public support is something that must be protected. Since space power is important for all United States’ Government operations, this makes public support an important national level center of gravity for the United States’ space power capability.

The first section discussed why public support and space are important. It then went on to outline, through a critical factor analysis, how the center of gravity might be broken down into critical capabilities, critical requirements, and critical vulnerabilities. Section two took a look

back at public support from the start of the space era; from its high during the Apollo program to the slow decline in the interest in STEM education. This led into section three's discussion of the current state of public interest and how countries like Russia and China aren't ignoring their space capabilities. Section four concludes the discussion on the public support center of gravity by suggesting a few ways in which public support can be generated to make the public support center of gravity more resistant to influence from unconventional style attacks or atrophy.

If anyone ever asks why public support matters, remember the words of President Abraham Lincoln, "With public sentiment, nothing can fail; without it nothing can succeed."⁹⁰



Bibliography

- Air University (AU)- 18. *Space Primer*. Maxell AFB, AL: Air University Press, 2010.
- Air Force Doctrine Annex, 3-2. *Airman's Perspective of IW*. 2013.
<https://doctrine.af.mil/download.jsp?filename=3-2-D03-IW-Airman-Perspective.pdf>
- Air Force Doctrine Annex 3-51. *Introduction to Electronic Warfare Operations*. 2011.
<https://doctrine.af.mil/download.jsp?filename=3-51-D01-EW-Introduction.pdf>
- Anderson, Jon, "Spec Ops Screen Idols: Film featuring SEALs began as recruiting ad, became passion project," *Navy Times*, February 2012, <http://www.navytimes.com/article/20120216/OFFDUTY02/202160304/Spec-ops-screen-idols-Film-featuring-SEALs-began-recruiting-ad-became-passion-project>
- Bhattacharjee, Yudhijit, "House Science Committee Wants NASA to Return to the Moon," *Science*, 19 June 2013, <http://news.sciencemag.org/2013/06/house-science-committee-wants-nasa-return-moon>
- Burrows, William E., *This New Ocean*. New York: Random House, 1998.
- Chiao, Leroy, "Astronaut Leroy Chiao: 'Gravity' Works, If You Don't Focus on the Physics." *Space.com*, October 2013, <http://www.space.com/23105-gravity-film-review-astronaut-leroy-chiao.html>
- Clausewitz, Carl Von. *On War*. Edited and translated by Michael Howard and Peter Paret. New Jersey: Princeton University Press, 1989.
- Dale, Ashley, "Space Research Pays for Itself, but Inspires Fewer People." *The Conversation*. March 2014. <http://www.space.com/24877-space-research-pays-for-itself-but-inspires-fewer-people.html>
- Derra, Skip. "Success of 'New Space' Era Hinges on Public's Interest." *SESE*, 15 November 2013, <http://sese.asu.edu/news/success-new-space-era-hinges-publics-interest>
- Dick, Steven J., and Roger D. Launius. *Societal Impact of Spaceflight*. Washington, DC: NASA, 2007.
- Ferdman, Roberto. "China's Exuberant Space Program Will Make You Feel Excited About Space Travel Again." *Quartz*, 12 July 2013, <http://qz.com/103217/china-space-program-will-make-you-feel-excited-about-space-travel-again/>
- Foust, Jeff. "Dysfunctional Space Advocacy." *The Space Review*, 23 November 2009, <http://www.thespacereview.com/article/1515/1>

- Garamone, Jim. "Shelton Discusses Importance of Space Defense." *Armed Force Press Service*. 2014. <http://www.defense.gov/news/newsarticle.aspx?id=121443>
- Howell, Elizabeth. *Columbia Disaster: What Happened, What NASA Learned*. Space.com, February 2013. <http://www.space.com/19436-columbia-disaster.html>
- Huff Post Education. "School Budget Cuts: How Students Say Slashes Are Affecting Them." *The Huffington Post*, 14 February 2014, http://www.huffingtonpost.com/2012/02/14/la-youth_n_1277182.html (Accessed 8 April 2014).
- Huff Post Politics. "Americans Mad at Everyone Over Federal Government Shutdown, But More Blame Republicans." *The Huffington Post*, 15 October 2013, http://www.huffingtonpost.com/2013/10/15/federalgovernment_n_4102263 (Accessed 9 April 2014).
- Joint Publication 3-14, *Space Operations*, 29 May 2013.
- Joint Publication 5-0, *Joint Operational Planning*, 11 August 2011.
- Kaufman, Philip, *The Right Stuff*, Warner Brothers, 192 min., 1984, DVD.
- Launius, Roger, *NASA: A History of the U.S. Civil Space Program*. Malabar, FL: Krieger Publishing Company, 1994.
- Launius, Roger, "Public Opinion Polls and Perception of US Human Spaceflight." *Space Policy*, 2003.
- Leone, Dan, "NASA's \$17.5 Billion Budget Request for 2015 Would Fund New Science Missions, Ground Flying Telescope," Space.com, 4 March 2014, <http://www.space.com/24914-nasa-2015-budget-request-revealed.html>
- Lichtblau, Eric, "With a Major Push, AARP Returns to a Hard Line Against Cuts in Benefits," *The New York Times*, 14 December 2012, http://www.nytimes.com/2012/12/15/us/politics/aarp-returns-to-a-hard-line-against-benefit-cutbacks.html?_r=0
- Marscionka, Vyintas, "Russia's Space Industry is About to Regain Its Former Glory. Or is it?" *Euromonitor International*, 4 July 2013, <http://blog.euromonitor.com/2013/07/russias-space-industry-is-about-to-regain-its-former-glory-or-is-it.html>
- Moskowitz, Clara. "Wanted: Married Couple for Private Mars Voyage in 2018," Space.com, 27 February 2013, <http://www.space.com/19981-private-mars-mission-married-2018>
- NASA, "Public Opinion of the American Space Program," <http://www.hq.nasa.gov/office/hqlibrary/pathfinders/opinion.htm>, (accessed 7 April 2014)

Neale, Rich, "23,000 now expected to lose jobs after shuttle retirement," *Florida Today*, February 2010. <http://www.floridatoday.com/article/20100226/NEWS0204/2260321/23-000-now-expected-lose-jobs-after-shuttle-retirement>

NFA, "About The NFA," <http://www.nationalflightacademy.com/about/about-the-nfa/>

Sellers, Jerry. *Understanding Space: An Introduction to Astronautics*. United State of America: McGraw-Hill. 2010.

Smith, M.V. *Ten Propositions Regarding Spacepower*. Maxwell AFB, AL: Air University Press, 2002.

Space Camp, "About Space Camp," <http://www.spacecamp.com/about>

SpaceX, "Company," SpaceX.com, <http://www.spacex.com/about> (Accessed 9 April 2014).

SpaceX, "Leadership," SpaceX.com, <http://www.spacex.com/about/leadership> (Accessed 9 April 2014).

Tate, Karl. *Columbia Shuttle Disaster Explained*. Space.com, February 2013. <http://www.space.com/19526-columbia-shuttle-disaster-explained-infographic.html>

The Challenger Center, "Overview," <http://www.challenger.org/about-us/overview/>

US House, *A Hearing Before the Subcommittee on Immigration Policy and Enforcement discussing "STEM" The Tide: Should America Try to Prevent an Exodus of Foreign Graduates of US Universities with Advanced Science Degrees*. 112th Congress, 1st Session, 2011. Serial Number 112-64.

Wall, Mike, "NASA Assessing Impacts of Government Shutdown," Space.com, 18 October 2013, <http://www.space.com/23253-nasa-government-shutdown-impacts.html>

Warden, John A. III. "Strategy and Airpower." *Air and Space Power Journal*. Spring 2011.

Wechsler, Jill. *The Role of GPS in Precise Time and Frequency Dissemination*. 1990. <http://ilrs.gsfc.nasa.gov/docs/timing/gpsrole.pdf>

Wright, Joshua, "How Foreign-Born Graduates Impact the STEM Workforce Debate," *Forbes*, 28 May 2013, <http://www.forbes.com/sites/emsi/2013/05/28/how-foreign-born-graduates-impact-the-stem-worker-shortage-debate/>

Wright, Mike, "The Disney-Von Braun Collaboration and It's Influence on Space Exploration," 1993, http://history.msfc.nasa.gov/vonbraun/disney_article.html

Ziarnick, Brent D., "The Space Campaign." *Air and Space Power Journal*. Summer 2004.

-
- ¹ Kaufman, Philip, *The Right Stuff*, Warner Brothers, 192 min., 1984, DVD.
- ² Launius, "Public Opinion Polls and Perceptions of US Human Spaceflight," 163.
- ³ Wechesler, *The Role of GPS in Precise Time and Frequency Dissemination*, 1.
- ⁴ Sellers, *Understanding Space*, 7.
- ⁵ Sellers, *Understanding Space*, 8.
- ⁶ Smith, *Ten Propositions Regarding Spacepower*, 5.
- ⁷ Smith, *Ten Propositions Regarding Spacepower*, 7.
- ⁸ Garamone, "Shelton Discusses Importance of Space Defense."
- ⁹ Joint Publication (JP) 5-0, *Joint Operational Planning*, III-23.
- ¹⁰ Clausewitz, *On War*, 485.
- ¹¹ JP 5-0, *Joint Operational Planning*, GL-6.
- ¹² JP 5-0, *Joint Operational Planning*, III-24.
- ¹³ Warden, "Strategy and Airpower", 69.
- ¹⁴ NASA, "Public Opinion of the American Space Program,"
<http://www.hq.nasa.gov/office/hqlibrary/pathfinders/opinion.htm>
- ¹⁵ Air University (AU) – 18, *Space Primer*, 273.
- ¹⁶ Annex 3-51, *Introduction to Electronic Warfare Operations*, 3.
- ¹⁷ Smith, *Ten Propositions Regarding Spacepower*, 64.
- ¹⁸ Smith, *Ten Propositions Regarding Spacepower*, 65.
- ¹⁹ Annex 3-2, *Airman's Perspective of IW*, 1.
- ²⁰ Annex 3-2, *Airman's Perspective of IW*, 1.
- ²¹ Ziarnick, "The Space Campaign," 63.
- ²² JP 5-0, *Joint Operational Planning*, III-23.
- ²³ JP 5-0, *Joint Operational Planning*, III-24.
- ²⁴ JP 5-0, *Joint Operational Planning*, III-25.
- ²⁵ JP 5-0, *Joint Operational Planning*, III-24.
- ²⁶ JP 5-0, *Joint Operational Planning*, III-24.
- ²⁷ Kaufman, Philip, *The Right Stuff*, Warner Brothers, 192 min., 1984, DVD.
- ²⁸ JP 5-0, *Joint Operational Planning*, III-24.
- ²⁹ US House, *A Hearing Before the Subcommittee on Immigration Policy and Enforcement discussing "STEM" The Tide*, 3.
- ³⁰ Dale, "Space Research Pays for itself, but Inspires Fewer People", <http://www.space.com/>
- ³¹ Dale, "Space Research Pays for itself, but Inspires Fewer People", <http://www.space.com/>
- ³² Wright, "How Foreign-Born Graduates Impact the STEM Workforce Shortage Debate", <http://www.forbes.com/>
- ³³ Wright, "How Foreign-Born Graduates Impact the STEM Workforce Shortage Debate", <http://www.forbes.com/>
- ³⁴ Wright, "How Foreign-Born Graduates Impact the STEM Workforce Shortage Debate", <http://www.forbes.com/>
- ³⁵ Launius, *NASA: A History of the U.S. Civil Space Program*, 17.
- ³⁶ Wright, "The Disney-Von Braun Collaboration and Influence on Space Exploration",
http://history.msfc.nasa.gov/vonbraun/disney_article.html
- ³⁷ Wright, "The Disney-Von Braun Collaboration and Influence on Space Exploration",
http://history.msfc.nasa.gov/vonbraun/disney_article.html
- ³⁸ Launius, *NASA: A History of the U.S. Civil Space Program*, 17.
- ³⁹ Launius, *NASA: A History of the U.S. Civil Space Program*, 17.
- ⁴⁰ Launius, *NASA: A History of the U.S. Civil Space Program*, 17.
- ⁴¹ Launius, *NASA: A History of the U.S. Civil Space Program*, 25.
- ⁴² Launius, *NASA: A History of the U.S. Civil Space Program*, 25.
- ⁴³ Launius, *NASA: A History of the U.S. Civil Space Program*, 29.
- ⁴⁴ Wright, "The Disney-Von Braun Collaboration and Influence on Space Exploration",
http://history.msfc.nasa.gov/vonbraun/disney_article.html
- ⁴⁵ Wright, "The Disney-Von Braun Collaboration and Influence on Space Exploration",
http://history.msfc.nasa.gov/vonbraun/disney_article.html
- ⁴⁶ Wright, "The Disney-Von Braun Collaboration and Influence on Space Exploration",
http://history.msfc.nasa.gov/vonbraun/disney_article.html
- ⁴⁷ Launius, *NASA: A History of the U.S. Civil Space Program*, 40.
- ⁴⁸ Launius, *NASA: A History of the U.S. Civil Space Program*, 40.

-
- ⁴⁹ Launius, *NASA: A History of the U.S. Civil Space Program*, 55.
- ⁵⁰ Dale, "Space Research Pays for itself, but Inspires Fewer People", <http://www.space.com/>
- ⁵¹ Burrows, *This New Ocean*, 556.
- ⁵² Burrows, *This New Ocean*, 556.
- ⁵³ Howell, *Columbia Disaster: What Happened, What NASA learned*, <http://www.space.com/>
- ⁵⁴ Howell, *Columbia Disaster: What Happened, What NASA learned*, <http://www.space.com/>
- ⁵⁵ Tate, *Columbia Shuttle Disaster Explained*. <http://www.space.com/19526-columbia-shuttle-disaster-explained-infographic.html>
- ⁵⁶ Neale, Rich, "23,000 now expected to lose jobs after shuttle retirement," <http://www.floridatoday.com/>
- ⁵⁷ Leone, "NASA \$17.5 Billion Budget Request for 2015 Would Fund New Science Missions, Ground Flying Telescope," <http://www.space.com/>
- ⁵⁸ Leone, "NASA \$17.5 Billion Budget Request for 2015 Would Fund New Science Missions, Ground Flying Telescope," <http://www.space.com/>
- ⁵⁹ Bhattacharjee, "House Science Committee Wants NASA to Return to the Moon," <http://news.sciencemag.org/>
- ⁶⁰ Wall, "NASA Assessing Impacts of Government Shutdown," <http://www.space.com/>
- ⁶¹ Huff Post Politics, "Americans Mad at Everyone Over Federal Government Shutdown, But More Blame Republicans," www.huffingtonpost.com
- ⁶² Huff Post Education, "School Budget Cuts: How Students Say Slashes are Affecting Them," www.huffingtonpost.com
- ⁶³ Marscionka, , "Russia's Space Industry is About to Regain Its Former Glory. Or is it?" *Euromonitor International*.
- ⁶⁴ Ferdman, "China's Exuberant Space Program Will Make You Feel Exited About Space Travel Again," QZ.Com
- ⁶⁵ Launius, *NASA: A History of the U.S. Civil Space Program*, 17.
- ⁶⁶ Ferdman, "China's Exuberant Space Program Will Make You Feel Exited About Space Travel Again," QZ.Com
- ⁶⁷ SpaceX, "Leadership," <http://www.spacex.com>
- ⁶⁸ SpaceX, "Company," <http://www.spacex.com>
- ⁶⁹ Moskowitz, "Wanted: Married Couple for Private Mars Voyage in 2018," <http://www.space.com>
- ⁷⁰ Derra, "Success of 'New Space' era hinges on Public Interest." *SESE*.
- ⁷¹ JP 3-14, *Space Operations*, GL-6.
- ⁷² Dick and Launius, *Societal Impact of Spaceflight*, 573.
- ⁷³ Space Camp, "About Space Camp," <http://www.spacecamp.com/about>
- ⁷⁴ Space Camp, "About Space Camp," <http://www.spacecamp.com/about>
- ⁷⁵ Space Camp, "About Space Camp," <http://www.spacecamp.com/about>
- ⁷⁶ The Challenger Center, "Overview," <http://www.challenger.org/about-us/overview/>
- ⁷⁷ NFA, "About The NFA," <http://www.nationalflightacademy.com/about/about-the-nfa/>
- ⁷⁸ Dick and Launius, *Societal Impact of Spaceflight*, 573.
- ⁷⁹ Dick and Launius, *Societal Impact of Spaceflight*, 415.
- ⁸⁰ Anderson, "Spec ops screen idols," www.navytimes.com
- ⁸¹ Chiao, "Astronaut Leroy Chiao: 'Gravity' Works, If You Don't Focus on the Physics," <http://www.space.com/>
- ⁸² Litchblau, "With a Major Push, AARP Returns to a Hard Line Against Cuts in Benefits," *The New York Times*.
- ⁸³ Dick and Launius, *Societal Impact of Spaceflight*, 559-560.
- ⁸⁴ Foust, "Dysfunctional Space Advocacy," <http://www.thespacereview.com>
- ⁸⁵ Dale, "Space Research Pays for itself, but Inspires Fewer People", <http://www.space.com/>
- ⁸⁶ Dale, "Space Research Pays for itself, but Inspires Fewer People", <http://www.space.com/>
- ⁸⁷ Dale, "Space Research Pays for itself, but Inspires Fewer People", <http://www.space.com/>
- ⁸⁸ Dale, "Space Research Pays for itself, but Inspires Fewer People", <http://www.space.com/>
- ⁸⁹ JP 3-14, *Space Operations*, II-1.
- ⁹⁰ NASA, "Public Opinion of the American Space Program," <http://www.hq.nasa.gov/office/hqlibrary/pathfinders/opinion.htm>